

ing off of  $\text{CO}_2$ . 5. Dessication acts in the reverse manner and, by diminishing the permeability, decreases the oxygen and tends to the storing up of a greater proportion of  $\text{CO}_2$ . 6. The nitrogen is passive and is carried as a by-product with the others. 7. The general conditions of gaseous interchange between fleshy plant structures and the rest of the plant or the outer air are best understood when we fix our attention upon the undoubted fact that there are three different kinds of interchange going on simultaneously, each of which is capable of modification by external or internal conditions. These are diffusion, effusion and dialysis.—CONWAY MACMILLAN.

### Effects of electricity on growth.<sup>1</sup>

In this paper Hegler has described the effects of electricity on the growth of plants. In it he has shown that certain plants respond to electrical stimuli in a similar manner as they do to light. In his experiments he used an apparatus like that used by Hertz. Hertz has already demonstrated that electricity presents quite the same phenomena as light; that the electric beam can be polarized, focused, reflected and refracted.

The apparatus consists briefly of four Bunsen elements, which are connected by an interrupter with a very large induction apparatus, consisting of many thousand feet of coil; from this the current is transmitted to two brass knobs of 1.5 cm. radii, which constitute the poles, and between which the electric spark is made to pass at regular intervals. The brass knobs are placed about 10 cm. apart in a vertical direction, so that the transverse electrical waves fall on the long axis of the plant which is situated 1–2 cm. from the electric spark.

For these experiments Hegler found the rapidly growing aerial hyphæ of *Phycomyces nitens* particularly well adapted, as it is well known that they are exceedingly sensitive to all external influences. The plants were cultivated on sterilized bread and covered with a black paper cylinder to prevent heliotropic bendings. He found in from 3 to 6 hours the hyphæ bend away from the electric source, from which he maintains they are negatively electrotropic. The angle of bending, however, he found somewhat smaller than that produced by intense light. Herr Hegler also experimented with reflected rays, both from a plain and parabolic metal reflector, from which he obtained similar results.

<sup>1</sup> ROBERT HEGLER:—Ueber die physiologische Wirkung der Hertz'schen Electricitätszellen auf Pflanzen. Leipzig.

When a cylindrical wire gauze was placed over the plant the hyphæ made no bendings, although a bell glass made no difference at all in their response to the electrical stimulation.  
—GEO. E. STONE.

### The vegetation of the paramos of Venezuela.<sup>1</sup>

This paper contains a general sketch of the vegetation of the paramos with reference to the distribution and appearance of certain plants, and an account of the biology of these xerophilous plants.

Some of the Compositæ are characteristic of the paramo vegetation. Transpiration is diminished in these plants in different ways; for instance, by a dense cover of woolly hairs, by the development of coriaceous leaves, sometimes small in size and with involute margins, or by the development of merely short stems with densely leaved rosettes and underground reservoirs of nutritive matters. These characters are not, however, strictly separated, for more than one may be observed upon the same plant. Several other families besides the Compositæ show the same peculiarities.

The leaves of *Espeletia* have an immense cover of long white hairs, which are bent into broad spirals, so as to form a layer many times thicker than the leaf-blade itself. Thus the plant is well protected against a too rapid change in temperature, against the exsiccating effect of the winds, and has at the same time gained control of the transpiration. The leaf has a distinct hypoderm, which probably serves as a water-reservoir, and the inferior face shows several longitudinal ribs, which border on corresponding cavities in the leaf-blade. The chlorophyll-bearing parenchyma covers the furrows between the ribs, and there are in the interior part of the leaf wide openings, which remind us of lacunes, but which are covered with hairs and provided with stomata. These openings have been formed merely by a turning inwards of the surface of the leaf-blade. Of other paramo-plants with similar covering of hairs are mentioned a *Plantago*, a *Lupinus*, and especially the remarkable *Jamesonia nivea*. This last shows an aspect widely different from other ferns; the pinules are horizontally spread out and cover each other as closely as the coins in a roll.

<sup>1</sup> K. GOEBEL:—Die Vegetation der venezolanischen Paramos. Pflanzenbiologische Schilderungen, Pars 2. Marburg 1891.